

Application No. 10/764,139
Art Unit 3746
Reply to Office Action Aug. 3, 2006

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WHAT I CLAIM IS:

Claim 21

A double-acting, reciprocating piston, high-pressure, cryogenic pump comprising;

- a cylinder;
- a piston rod;
- a pair of spaced apart piston heads on said piston rod;
- each of said piston heads having a set of high-pressure seals;
- at least one venting passageway for venting blow-by vapors or fluids between said piston head seals;
- said venting passageway communicating with at least one venting passageway in said piston rod;
- said venting passageway in said ejecting said blow-by vapors into a source of suction liquid where said blow-by vapors mix and condense;
- whereby blow-by vapors or fluids are reclaimed and do not interfere with the normal operation of said cryogenic pump.

Claim 22

As in Claim 21 wherein the selection of the number of seals in a set of seals is the choice of the designer of said cryogenic pump.

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Claim 23

As in Claim 21 wherein said double-acting, high-pressure cryogenic pump has reduced peak torque, smoother suction and discharge flows, reduced heat leak and improved suction performance relative to a single-acting, high-pressure reciprocating piston pump of similar capacity and pressure rise.

Claim 24

A double-acting, reciprocating piston, high-pressure pump, as in Claim 21 having reduced cost of installation compared with two, single-acting, high-pressure reciprocating pumps operating in parallel of similar pressure rise and total capacity.

Claim 25

A double-acting, reciprocating piston, high-pressure, cryogenic pump comprising:
a cylinder;
a piston rod;
a pair of spaced apart piston heads on said piston rod;
each of said piston heads having a set of high-pressure seals;
said cylinder having a least one vent hole passageway in a plane approximately midstroke of said piston head seals;
said venting passageway in said cylinder causing said blow-by vapors between said sets of seals to vent into a source of suction liquid where the vapors mix and condense;

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whereby blow-by vapors are reclaimed and do not interfere with normal operation of said cryogenic pump.

Claim 26

As in claim 25 wherein the selection of the number of seals in a set of seals is the choice of the designer of said cryogenic pump.

Claim 27

As in Claim 26 wherein said double-acting, high-pressure cryogenic pump has reduced peak torque, smoother suction and discharge flows, reduced heat leak and improved suction performance relative to a single-acting, high-pressure reciprocating piston pump of similar capacity and pressure rise.

Claim 28

A double-acting, reciprocating piston, high-pressure pump as in Claim 25 having reduced cost of manufacture and reduced cost of installation compared with two, single-acting, reciprocating pumps operating in parallel of similar pressure rise and total capacity.

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Claim 29

Providing the major components for the cold end of a double-acting, reciprocating piston, high-pressure cryogenic pump comprising:

a cylinder;

a piston rod;

a pair of spaced apart piston heads on said piston rod;

a set of high-pressure seals on each of said piston heads;

said high-pressure seals slidable in the bore of said cylinder;

said cylinder having cylinder heads at opposite ends with pressure operated suction and discharge valves;

cooling said cylinder and said cylinder heads with an enclosing insulating jacket connected to a source of cryogenic suction fluid;

a low pressure cavity between said spaced apart sets of high-pressure seals;

communicating said low pressure cavity with said source of cryogenic suction fluid via at least one passageway;

high-pressure blow-by fluid leaking past said high-pressure seals flashes to cold, low-pressure vapor as said leaking, high-pressure fluid enters said low-pressure cavity;

said blow-by vapors mix and condense in said cryogenic suction fluid;

whereby blow-by vapors are reclaimed and condensed so they do not interfere with the normal operation of the said double-acting high-pressure cryogenic pump.

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